Original article

Development and Implementation of an Oral Health Data Registration and Evaluation System for the Belgian Population

Dominique Declerck,[1] Peter Bottenberg,[2] Joana Carvalho,[3] Catherine Declerck,[4] Eddy De Vos,[5] Astrid Vanden Abbeele,[6] Jean-Pierre Van Nieuwenhuysen,[7] Jacques Vanobbergen,[8] Kris Bogaerts.[9]

[1, 4] KU Leuven Department of Oral Health Sciences & Dentistry, University Hospitals Leuven, Belgium; [2] Conservative Dentistry and Prosthodontics, Free University Brussels (VUB), Brussels, Belgium; [3, 7] Faculty of Medicine and Dentistry, Catholic University of Louvain, Brussels, Belgium; [5, 8] Community Dentistry and Oral Public Health, Dental School, Ghent University, Ghent, Belgium; [6] Department of Restorative and Paediatric Dentistry, Free University Brussels (ULB), Brussels, Belgium; [9] Interuniversity institute for Biostatistics and Statistical Bioinformatics (I-BioStat), KU Leuven, Leuven and University Hasselt, Hasselt, Belgium.

Journal of Dental, Oral and Craniofacial Epidemiology 2013; Vol 1 No. 3. Pg 45-54
Corresponding Author: Dominique Declerck. email: dominique.declerck@med.kuleuven.be

ABSTRACT

Objective. Information regarding health condition, related behavior and utilization of health care services is essential for planning and organization of care delivery. Until recently, only limited information regarding oral health related issues was available in Belgium. This paper illustrates the development and implementation of an Oral Health Data Registration & Evaluation System (OHDRES) in Belgium, including discussion of challenges encountered. **Methods.** After development of a conceptual plan and pilot phase, the OHDRES was implemented nationwide in 2009-2010. The combined Health Interview (self-administered questionnaire) and Health Examination (standardized oral examination by trained dentist-interviewer at the participant's home) data were supplemented with data on utilization of (oral) health care services. Sampling of Belgian residents (> 5 years) took place using a multi-stage, stratified cluster sampling procedure. Ethical approval was obtained and informed consent was sought from all participants. **Results.** A total of 2536 households were reached, yielding 3057 respondents (52%). Questionnaire and clinical data were obtained from 90% and 84% of participants. Dentist-interviewers reported difficulties with scoring of periodontal condition and enamel defects. Contacting selected households was the most difficult and time-consuming task for the dentist-interviewers, impacting on retention rate. **Conclusion.** The first round of the Belgian OHDRES was successfully implemented, after long and complex preparation. The impossibility of integration with the National Health Interview Survey 2009 was a considerable draw-back complicating data collection and limiting opportunities to further data linking and creation of added value.

Keywords: Epidemiology, population survey, oral health, health interview survey, health examination survey.

The collection of information regarding the health condition, health related behaviors and utilization of health care services of a population is essential for an efficient planning of care delivery, both preventive and curative, and optimal allocation of resources. To this end, health interview surveys (HIS) and health examination surveys (HES) have been developed in several countries (1).

In Belgium, the Scientific Institute of Public Health (IPH) organizes every four years a Health Interview Survey of the Belgian population. This survey contains only very few items related to oral health. Until recently, data regarding the oral health situation of the Belgian population were very limited. Some initiatives, mainly launched by universities, report on the caries experience in young children (<12 yrs) (2-7) or oral health condition of elderly (8) and/or handicapped (9, 10). Therefore, the "Steering Committee for quality promotion amongst dentists" of the National Institute for Health and Disability Insurance (NIHDI) launched the initiative to establish an Oral Health Data Registration and Evaluation System (OHDRES) with the overall objective to obtain an accurate picture of the oral health status and treatment needs of Belgian inhabitants and to provide an instrument and scientific base for policy development regarding oral health. For this purpose, an interuniversity consortium of representatives of Belgian universities responsible for the academic training of dentists was created: the Interuniversity Consortium of Epidemiology or ICE. This paper aims to present the set-up and implementation of such an Oral Health Data Registration and Evaluation System, including an evaluation of the procedures used and discussion of problems and challenges encountered.

As a first step, in 2003, ICE developed a conceptual plan regarding oral health data registration applicable in the Belgian context. This plan was based on an extensive review of the literature, analyzing existing systems worldwide, and an exploration of the possibilities to implement such a system within the Belgian situation (11). The central idea was to make maximum use of relevant information

from existing databases and to supplement this with oral health data (obtained by clinical examination) and oral health related habits (obtained by questionnaire). It was proposed to use the sample of the national health interview survey (IPH) to this end, facilitating the inclusion of general health related information, and to supplement this with information on the utilization of (oral) health care services available at the NIHDI.

This paper aims to present the design and implementation of this Oral Health Data Registration and Evaluation System, including an evaluation of the procedures used and discussion of problems and challenges encountered.

METHODS

Pilot study

After approval of the conceptual plan by the NIHDI, a pilot study was undertaken (2006-2008). The main objective of the pilot study was the evaluation of the practical feasibility of the proposed concept. The pilot study included an evaluation of the implementation of the self-reported structured questionnaire as well as the testing of two different approaches concerning the oral examination: asking participants to visit a (private) dentist of their own choice or organizing the examination at the participants' home making use of a team of trained dentist-interviewers.

The field work was tested in a sample of 381 persons and involved 45 dentists (12). Dentist-interviewers trained by ICE performed better (lower number of incorrect/missing entries on clinical forms; 36% by ICE dentist-interviewers versus 64% by private dentists of own choice). Furthermore, participants themselves did not show any preference regarding the way of having the oral examination (50.3% private dentist of own choice versus 49.7% ICE dentist-examiner) (12).

Reproducibility of the survey questionnaire was tested using a test-retest procedure: 39 test persons recruited across several university campuses and in different age groups filled out the questionnaire twice with a minimal interval of one week. Reproducibility was excellent for 28% of the surveyed items (kappa $\geq$ 0.8), good (kappa between 0.6 and 0.8) for 40% and fair (kappa between 0.4 and 0.59) for 13% of the items (12).

Based on the pilot study, changes were proposed to the questionnaire (reformulation of questions in order to improve their clarity, addition of instructions to the section concerning nutrition and restriction of questions regarding quality of life to persons 15 years and above). Regarding the clinical examination, it was suggested to score periodontal status per sextant and not for individual teeth, to simplify caries experience scoring at root surface level by using summary scores and to plan additional training for the scoring of the number of functional occlusal contacts (12).

This tested and fine-tuned conceptual plan was accepted by the NIHDI who decided to implement the data registration nation-wide for the first time in 2009.

Overview of the OHDRES-2009 survey design

At the end of 2009, the validated and tested system (OHDRES-2009) was implemented nationwide for the first time. The Belgian OHDRES-2009 consisted of both a HIS (data collected by means of a self-administered questionnaire) and a HES (data obtained by means of an oral examination), supplemented with information on the frequency of utilization of selected (oral) health care services registered by the NIHDI. Participants were visited at home by a dentist-interviewer and were invited to complete a questionnaire and to undergo an examination of the oral cavity.

Ethics

The OHDRES-2009 was approved by the Ethical Committee of the University of Ghent, Belgium. Written informed positive consent was obtained from the participants or, when indicated, from participant's proxy. Acceptance or refusal was possible separately for the interview, the oral examination and the retrieval of information on the utilization of health care services. Potential respondents were given the opportunity to refuse participation or to withdraw completely from the survey at any stage.

Sampling

Sampling of Belgian residents took place following the methodology used for the National Health Interview Survey (13). The target population consisted of all persons (> 5 years old) figuring in the National Register of Belgium on the 1st of the month preceding the month in which the sample was drawn. The sample was updated after three months, allowing the use of most recent and actual information. For pragmatic reasons, some categories of persons were excluded from the sample: persons younger than 5 years, persons residing in prison or in a religious community, institutionalized persons (except residents of nursing homes and residential care centers). A multi-stage, stratified cluster sampling technique was used in order to obtain a sample representative of the Belgian population with a 10% oversampling of persons 75 years and older (Figure 1). The first stage was stratification by region. The second stratification

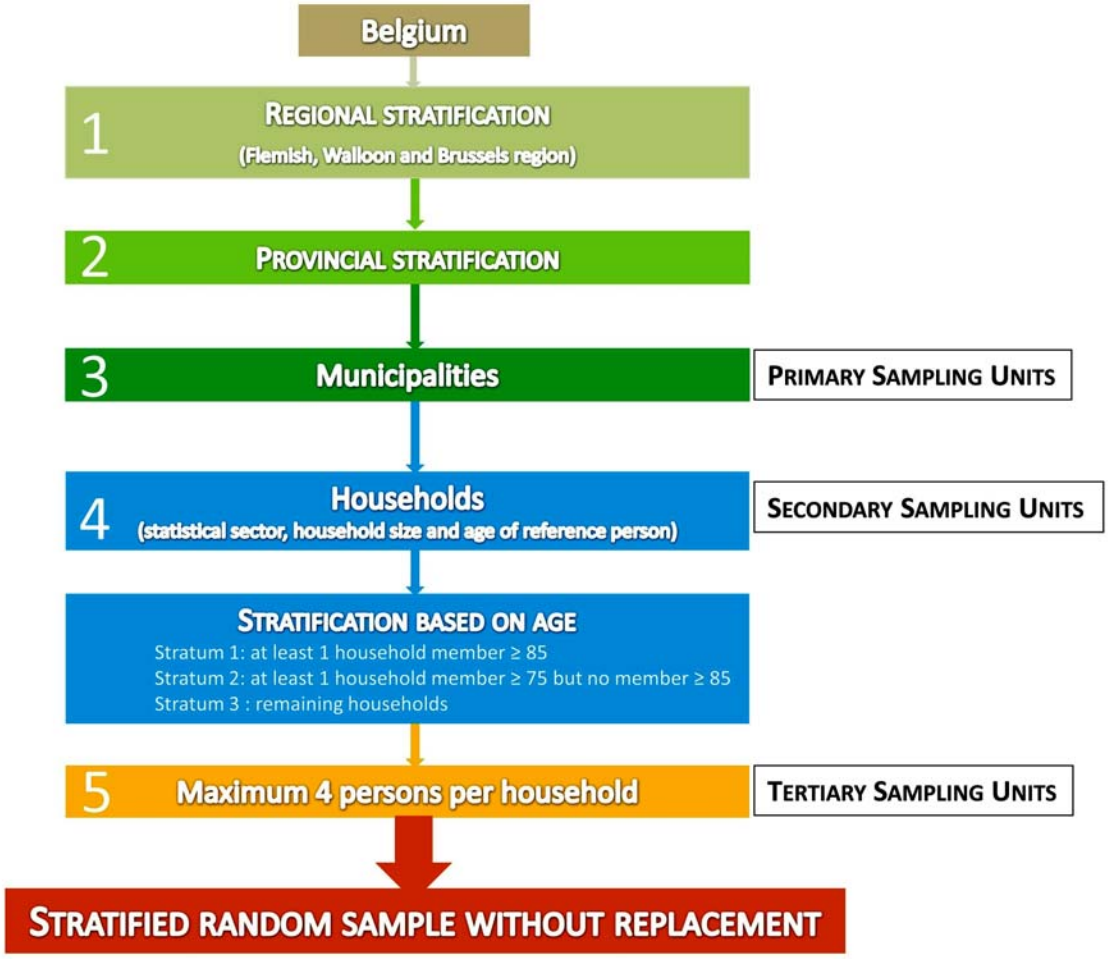

Figure 1.
Outline of the multi-stage, stratified cluster sampling procedure used for the OHDRES-2009.

was at the level of the provinces (with subdivision of the province of Liège in two parts: the German speaking community and the rest of the province) with a sample size defined proportional to the population size of the province. These first steps resulted in 12 strata. In the third step primary sampling units (PSU) were randomly selected within each stratum. The PSU's were defined as the municipalities of Belgium. The number of municipalities selected per province was defined proportionally to the population size of the province. The selection probabilities of the municipalities within provinces were proportional to the population sizes of the municipalities. In total, 159 municipalities were selected. In a fourth stage, households, the secondary sampling units (SSU), were selected using a clustered systematic sampling procedure after ranking the households hierarchically by statistical sector (a territorial subdivision of a municipality), household size and age of the reference person (head of household). The number of households to be selected in order to obtain interviews with 50 individuals in each PSU was estimated using the average household size of the municipality. The households were stratified in 3 strata based on the age of the household members: (1) households with at least 1 member older than 85 years, (2) households with at least one member older than 75 years but no members older than 85 years, (3) remaining households. This stratification was performed in order to obtain an oversampling of 75 year olds and an extra oversampling of 85 year olds. In a final step the individual sampling unit was selected within the households. A maximum of 4 persons were interviewed/examined within each household. The first two subjects were selected by definition: the reference person and his/her partner. The two (three when the reference person had no partner) other individuals were selected based on a birthday rule: the persons who had their birthday coming up first after the date of the interview were selected. In order to offset the problem of a low participation rate, replacement households sharing the same characteristics (municipality, statistical sector, age of the reference person and number of household members) were used to substitute initially selected households that could not be contacted or refused to participate.

All selected households received an information

leaflet and an invitation letter concerning the OHDRES-2009 from ICE's central office. The letter informed the participants of the fact that they would shortly thereafter be contacted by a dentist-interviewer.

Dentist-interviewers

All Belgian dentists were informed about the upcoming OHDRES-2009 by a letter from the NIHDI and communication by the Belgian dental professional associations to their members. Dentists interested in participating in the project were invited to an information session, organized by ICE, where the different aspects of the study set-up and fieldwork were explained and the oral examination procedure was demonstrated. Participating dentist-interviewers were provided with a manual describing the guidelines for the interview and a detailed illustrated brochure explaining the oral health screening procedure and criteria. A total of 71 dentists participated in the training and calibration sessions. They were trained in the registration of the oral health conditions. Calibration was undertaken using a series of full-mouth photographs simulating the clinical examination of patients, set up in a PowerPoint presentation (14). Five members of ICE, with expertise in epidemiological screening, established the gold standard for the clinical examination to be used during calibration. For detection of caries experience (dmft/DMFT>0) a sensitivity of 99.6% and a specificity of 69% was obtained; for scoring the presence of plaque a sensitivity of 89% and specificity of 69%.

The dentist-interviewers were responsible for contacting the selected households within their geographical area. When a household agreed in participating to the survey, the dentist-interviewer fixed an appointment and went to the household's home to interview/examine the selected members. The dentist-interviewer carried out the oral examinations and provided help with completing the questionnaire, if needed.

Dentist-interviewers received a fixed fee per file that was returned to ICE, the amount depending on the completeness of the file (questionnaire data and/or oral examination data, or refusal of the subject to participate).

Oral health questionnaire

The final version of the questionnaire consisted of 34 questions covering socio-demographic information (age, gender, nationality, residence, education level, employment), oral health related habits (oral hygiene, dietary habits, dental attendance etc.), presence of oral complaints, oral health related quality of life (OHIP-14) (15) and general health information (chronic diseases or disabilities, diabetes, Body Mass Index, tobacco consumption, Table 1). All questions were based on existing validated and reliable measuring instruments retrieved from the international literature.

The self-administered questionnaire was presented in paper form to the participants. The data of young children (between the ages of 5 and 15 years) were obtained by proxy. A proxy-respondent was also used for persons suffering from cognitive impairment. In these cases, another member of the family, relative or close neighbor (proxy) answered the survey. The completed questionnaire was handed over to the dentist-interviewer who forwarded the information to ICE for further processing.

Clinical examination

The clinical examination included a wide range of variables (see also Table 1): presence of dentofacial anomalies (crowding, malocclusion), level of oral hygiene (plaque index), periodontal condition (Dutch Periodontal Screening Index or DPSI), tooth wear (erosion, abrasion, attrition), developmental defects of enamel (fluorosis, hypoplasia), caries experience, presence of sealants and restorations, prosthodontic status and type of prosthesis, functional occlusal contacts etc. For each of these variables, existing standardized criteria were used (15-21), in most cases identical to those proposed by the European Global Oral Health Indicators Development project (EGOHID) (22).

The clinical examinations were carried out by the dentist-interviewers, in the participant's home, with the participants sitting on an ordinary chair, preferably in a well lit room (e.g. the kitchen). The mouth was examined using a dental mirror and periodontal probe; cotton rolls for removal of debris were available (disposable, sterile oral examination kit, Kerr®, Kerr-Hawe, Bioggio, Switzerland). The dentist-interviewers were equipped with a head lamp (Eijlander Electronics, Ede, the Netherlands) to improve visibility.

Data were entered by the dentist-interviewer on a paper form at the patient's home and later on entered in a central database using a specifically developed and validated online data entry tool (Oral Survey- B) (23). In this way, the occurrence of missing, erroneous and contradictory data could be limited.

Logistics

In order to manage the fieldwork of the survey, a permanent central office was installed. This central office was responsible for the practical implementation of the fieldwork (announcing the survey,

communication with the dentist-interviewers, follow-up of the fieldwork, reception of the collected data, data management etc.). Contact was maintained with the dentist-interviewers through a communication form and a follow-up form. These forms were designed as a working tool for the interviewer to register all contact attempts with the households and to keep the secretariat informed on the progress of the field work.

A website (www.ice.ugent.be) was launched to support the project. All information and the latest news concerning the project were placed on this website. Participating dentists had access to a protected area of the website where they could find all necessary documents and a link to the online registration tool for entering the clinical examination data. Via the FAQ topic they could quickly find an answer to most of their questions.

Utilization of health care services

Belgium uses a system of compulsory medical insurance which includes dental insurance. This health care insurance covers more than 95% of the Belgian residents. Approximately 75% of the nationally agreed fees for preventive and restorative care, removable dentures, and minor oral surgery are reimbursed. Information on selected items regarding the utilization of dental and medical health care services (period 2005 to 2009) registered by the Belgian health insurance funds (grouped within the Inter-Mutualistic Agency (IMA)) was retrieved. The information included registered utilization of health care services considered relevant with regard to oral health: (regular) dental visits; emergency dental treatment sessions; preventive, restorative and orthodontic treatment sessions; periodontal treatments; consultations with oral surgeon, general physician or specialist; visit to emergency department. In addition, the health insurance status of the participant was retrieved (for more details, see Table 1).

Data management

Clinical data were saved on secured servers at the Free University of Brussels (VUB) using fault-tolerant systems with regular backup; questionnaire data were kept on an ICE-computer with regular backup.

The retrieved oral health data (questionnaire and clinical examination) were cleaned: illogical or contradictory data were verified and, if possible, corrected on the basis of the original data sheets. Next, the information was compiled with the health care service utilization data into a single global oral health database. For this purpose, a complex procedure needed to be developed in order to comply with requirements issued by privacy protection regulation. First, ICE linked the data from the questionnaire and oral examination. A file containing only the National Register Numbers (NRN) of the participating individuals having consented with the procedure, was forwarded to IMA. Data on the utilization of health care services of these individuals were retrieved and transferred by IMA to e-Health (e-platform for patient related data acting as trusted third party). Data collected by ICE, also labeled with the NRN, were likewise transferred to e-Health. After linking (based on NRN) and anonymization, the global database was transferred to the Biostatistics and Statistical Bioinformatics Centre of KU Leuven (L-BioStat) for analysis. Results were handed over to ICE for final reporting.

Data analysis

An ICE statistical codebook prespecifying all variables to be created and the frequency tables and cross-tabulations to be listed was written.

Descriptive statistics (mean, standard deviation, median, interquartile range and range or numbers and percentages, whichever is applicable) were calculated taking the sampling design into account. That is, a weighted analysis (weights according to 5-year age categories per province) stratified for province and with standard deviations taking the clustering within a PSU into account, was performed (see Appendix). No correction for non-participation or non-response was made.

Protection of personal data and private life

For the sampling procedure (making use of the NRN) and data linkage to data on utilization of health care services, additional permissions were needed. Authorization by the Sector Committee of the National Register allowed the National Register to vouch for the sampling of the project and permitted the use of the NRN.

Further, authorization from the Sector committee Social Security and Health within the Commission for the Protection of Privacy was obtained permitting the linking of the data gathered by ICE (questionnaire and oral examination) with data on utilization of health care services provided by IMA and the transfer of the compiled global oral health database to L-BioStat for data analysis.

Evaluation

Different steps of the procedure followed within the OHDRES-2009 were critically evaluated. All incoming questions, remarks and feedback received from the dentist-interviewers and participating households were carefully recorded by ICE. Dentist-interviewers were invited to take part in

Table 1. Overview of variables collected within the OHDRES-2009

Socio-demographic information	Utilization of health care services (§)	Oral health related habits	Clinical examination
Age groups **Gender** • Female • Male **Origin** • Nationality • Country of birth **Region of residence** • Brussels • Flanders • Wallonia **Municipality** • Postal code **Social Background** • Education level • Employment	**Oral health care services** • Dental visits • Preventive acts • Restorations • Endodontic treatments • Radiographs • Contacts with emergency services • Periodontal treatments • Stomatology and maxillofacial surgery • Implants • Narcodontics (dental extractions) • Prosthetic treatments • Minor oral surgery • Orthodontic treatments **General health care services** • General practitioner visits • Specialist visits • Use of emergence service **Health insurance status** • OMNIO benefit* • WIGW benefit†	**Oral hygiene** • Frequency of brushing • Use of oral hygiene tools • Fluoride use **Dietary habits** • Frequency eating • Frequency drinking • Eating moments • Drinking moments **Dental attendance** • Advice • Barriers **Oral complaints** **Oral Health and Quality of Life** **General health** • Chronic diseases or disabilities • Diabetes • Body Mass Index • Tobacco consumption	**Dentofacial anomalies** • Crowding • Malocclusion **Oral hygiene level** • Plaque Index **Periodontal condition** • DPSI‡ **Tooth wear** • Erosion • Abrasion • Attrition **Developmental defects of enamel** • Hypoplasia • Fluorosis **Dental status** • Caries experience (tooth level) • Sealants • Restorations • Missing teeth • Non-emerged teeth • Dental trauma • Implants **Prosthodontic status** • Presence • Type **Functional occlusal contacts**

§ Frequency of utilization of registered health care services (period 2005 to 2009)
*OMNIO: benefit for residents whose family income is below a certain limit
†WIGW: benefit for surviving spouses, individuals with disabilities, pensioners and orphans whose family income is below a certain limit, long-term unemployed above age 50 years, children entitled an increased child benefit, and residents entitled benefits for individuals with disabilities.
‡DPSI= Dutch Periodontal Screening Index

two evaluation meetings where they had the opportunity to express their views, to exchange useful tips and to communicate with the members of ICE.

Participating dentists were questioned on the time they spent on the project (preparation of the home visits, oral examinations and administration), the quality of the guidelines they received, and the clarity, relevance and practical aspects of the different clinical parameters.

RESULTS

The OHDRES-2009 ran between October 2009 and December 2010.

Sample

A total of 2536 households, aiming for a total sample size of 6750 subjects, were contacted (personally or by phone). Written informed consent was obtained from about half of these households (52%), resulting in a total of 3057 respondents. Lack of interest (51%) was the main reason for non-participation. The majority of participants (90%) filled out the questionnaire and 84% underwent the oral examination.

Seven percent of the respondents did not have the Belgian nationality. More than one third (35%) of participants had a higher education diploma. More than half of the individuals (55%) had no professional activity (e.g., 36% of them were students, 44% were retirees, and 5% were unemployed).

Dentist-interviewers

Between the moment of recruitment of the dentists and the actual start of the survey, 9 out of 71 dentist-interviewers dropped out because of changes in their professional occupation. During the first quarter of the survey, 20 dentists refrained from further cooperation and six dentists joined the team. Finally, 48 dentist-interviewers were active at the end of the project.

Oral health questionnaire

Few or no remarks related to the questionnaire were reported during the fieldwork.

Clinical examination

Dentist-interviewers (34 out of 68 dentist-interviewers active during (some period of) the survey) reported that the DPSI was the most problematic clinical parameter to score (only 36% assessed its scoring as feasible or very feasible (score 4 or 5 on a 5-point Likert scale)) (Figure 2). The scoring of defects in enamel was considered totally non-feasible or non-feasible to score by 6% and 11% of dentist-interviewers respectively.

The examination forms that were forwarded in paper format were not always clearly filled out (scores missing, unreadable annotation). Once den-

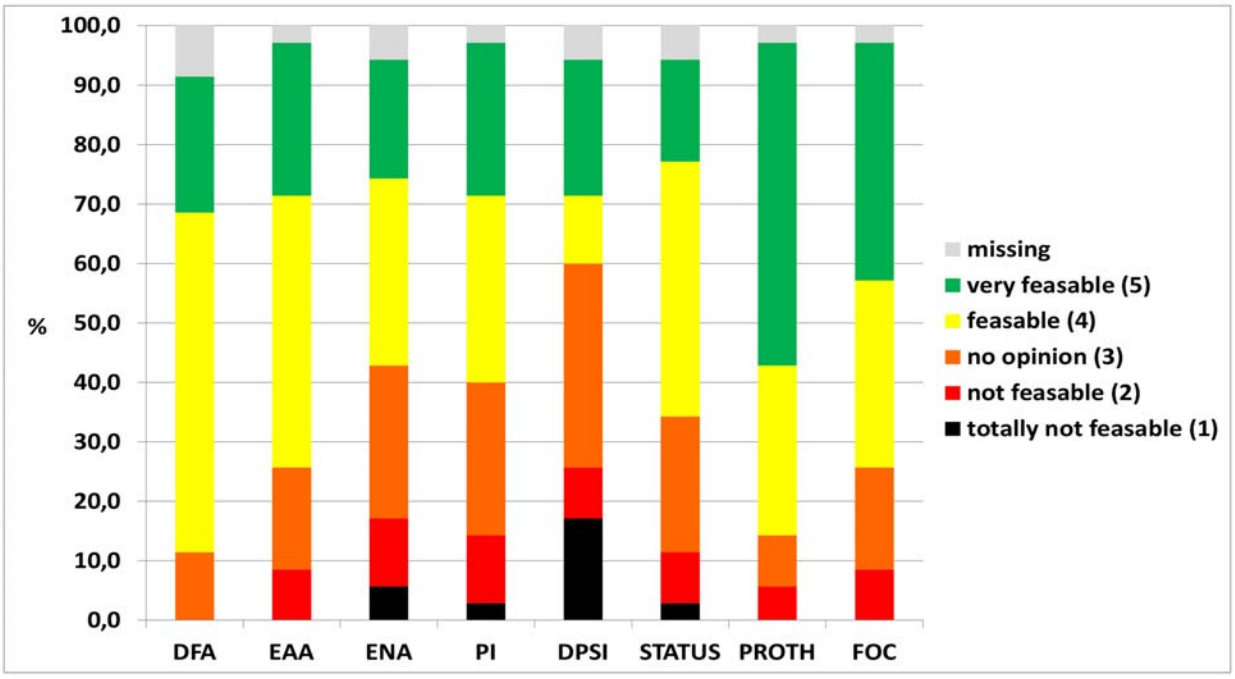

Figure 2.
Evaluation (by questionnaire) of the feasibility of the clinical examination (based on a 5-point Likert scale; 34 participating dentist-interviewers). (FOC: functional occlusal contacts; PROTH: presence and type of denture; STATUS: dental status; DPSI: Dutch Periodontal Screening Index; PI: Plaque Index; ENA: developmental defects of enamel; EAA: erosion, abrasion, attrition; DFA: dentofacial anomalies).

tist-interviewers got used to the online registration system, no further problems were encountered with the registration and faulty input could be reduced to a minimum.

Evaluation meetings with dentist-interviewers

During the evaluation meetings (attended by 22 and 12 dentist-interviewers each) it became clear that contacting the selected households was the most difficult and time consuming task for the dentist-interviewers. Telephone numbers proved difficult to retrieve due to an increasing use of mobile phones not appearing in telephone directories. Dentist-interviewers also reported that several households tried to contact their own dentist after having received the invitation letter and information brochure. Communication with elderly was sometimes difficult and the participants preferred to wait for one of their children to assist them.

It was also raised that respondents had difficulties in understanding the information letter and consent form; some participants were even intimidated by their complexity (due to the strict conditions imposed by the ethical committee).

Dentist-interviewers were satisfied with the information they received (77%) and reported only minor problems with the clinical examination. The majority of the dentist-interviewers (85%) needed less than 20 minutes to read the guidelines. The clinical examination took less than 30 minutes for 91% of the dentist-interviewers. Most dentist-interviewers were positive about the relevance (81%) and quality (77%) of the instructions for the dental examination. The administrative tasks after the home visit took most dentist-interviewers (82%) less than 20 minutes.

DISCUSSION

This paper elaborates on the design and implementation of a nation-wide oral health data registration system in Belgium, including an evaluation of the procedures used and discussion of problems and challenges encountered.

The system described in this report is an example of a combined HIS and HES, completed with registered data on the utilization of (oral) health care services. This exercise of setting up such a data registration system proved to be a complex exercise, requiring permissions from several administrative entities and cooperation from diverse services and organizations. The combination of the collected information with data retrieved from existing databases resulted in a considerable added value which is currently allowing comprehensive data analyses to be performed.

Initially, ICE aimed to integrate an oral health module into the national Health Interview Survey 2008 organized by the IPH. This would have allowed the use of exactly the same sample and linking of the global oral health database with information from the national HIS. However, this turned out impossible because of strict regulations issued by the Directorate General for Statistics and Economic Information. It was not possible to obtain a posteriori a key to link the different databases at the level of an individual (this request was not included in the initial application for sampling on behalf of the HIS-2008 survey). As a result, ICE asked the National Register to draw a separate sample but with exactly the same stratification as used for the IPH sample 2008.

The oversampling procedure that was adopted, lead to a final sample with distribution of age groups corresponding quite well to that in the general Belgian population. Also other socio-economic variables like nationality, education and employment matched well. However, it should be mentioned that the moderate participation level could be a source of non-responder bias.

The impossibility to work with the IPH-interviewers, necessitated that the ICE dentist-interviewers had to contact the selected households themselves by first trying to find the household's phone number (the National Register does not list telephone numbers). This proved to be a difficult and time-consuming task. Additionally, insufficient training of the dentist-interviewers in this matter, contributed to a considerable drop-out of dentist-interviewers.

In further rounds of the oral health data registration survey, connecting to the IPH survey is envisaged. This will imply the use of survey specialists from the IPH and is anticipated to facilitate the work of the ICE dentist-interviewers (by reducing considerably the time spent to contact the households, reducing the time interval between contacting the households and the actual visit of the dentist-interviewer and enhancing the response rate and retention of candidate dentist-interviewers). In addition, this allows further linking of the collected information with data collected in the IPH survey, creating added value.

In order to increase the retention of dentist-interviewers feedback sessions will be organized at regular intervals during the data collection period. In addition, the ICE website will be further developed including a more elaborated FAQ section intended for the participating dentist-interviewers.

Some clinical variables proved difficult to score. The problems mentioned regarding the scoring of the DPSI can be attributed to the sub-optimal

scoring circumstances at the respondent's home and because practicing dentists became familiar with this index only recently. Further, it is unusual for clinicians to score developmental defects of enamel routinely.

The online tool for data entry that was developed and validated by ICE functioned well for the clinical data collection and will be extended to the oral health questionnaire data in future survey rounds. The above mentioned proposals will be implemented for the OHDRES-2013.

CONCLUSION

For the first time a nation-wide oral health survey was organised in Belgium. The preparation process was long and complex. This report describes in detail the development and implementation of this oral health data registration and evaluation system, including some critical reflections. Results of the OHDRES-2009 will be presented in separate reports.

Experience obtained in the Belgian context might be relevant for other parties interested in or engaging in the set-up of a national oral health data registration system, especially in a setting without established dental public health service.

The initial conceptual plan needed fine-tuning, for which the pilot study proved to be essential. Although an extensive pilot study was performed, implementation proved to be challenging necessitating several modifications, mainly triggered by external circumstances and changes in legislation during the process and thus requiring a high flexibility of the survey team.

At each stage, it was extremely time consuming to obtain the necessary permissions from the respective authorities. In addition, the informed consent procedure was very elaborate and possibly had an influence on the response rate. Further research is needed to explore its impact on the validity of the results.

Finally, the recruitment of private dentists to act as dentist-interviewer proved to be challenging, probably because in the Belgian setting there is no history of dentists working in (dental) public health. It is worth exploring the possibility to introduce data registration as a subject in the obligatory vocational training of (recently graduated) dentists planning to work under the national health insurance system in Belgium.

ACKNOWLEDGEMENTS

The research presented in this report was commissioned and financed by the "Steering Committee for quality promotion amongst dentists" of the Belgian NIHDI. The authors thank all dentist-interviewers and participants for their collaboration.

REFERENCES

1. European Health Surveys Information Database project (EUHSID): http://www.euhsid.org/database.html
2. Vanobbergen J, Martens L, Declerck D. Caries prevalence in Belgian children: a review. Int J Paed Dent 2001; 11:164-170.
3. Carvalho JC, Van Nieuwenhuysen JP and D'Hoore W. The decline in dental caries among Belgian children between 1983 and 1996. Community Dent Oral Epidemiol 2001; 29:55-61.
4. Van Nieuwenhuysen JP, Carvalho JC, and D'Hoore W. Caries reduction in Belgian 12-year-old children related to socio-economic status. Acta Odontol Scand 2002; 60:123-128.
5. Carvalho JC, D'Hoore, Van Nieuwenhuysen JP. Caries decline in the primary dentition of Belgian children over 15 Years. Community Dent Oral Epidemiol 2004;32:277-282.
6. De Vos E, Vanobbergen J. Caries prevalence in Belgian children: a review. Archives of Public Health 2006;64:217-229.
7. Declerck D, Leroy R, Martens L, Lesaffre E, Garcia-Zattera M-J, Vanden Broucke S, et al. Factors associated with prevalence and severity of caries experience in preschool children. Community Dent Oral Epidemiol 2008;36:168-178.
8. De Visschere L, Schols J, van der Putten GJ, de Baat C, Vanobbergen J. Effect evaluation of a supervised versus non-supervised implementation of an oral health care guideline in nursing homes: a cluster randomised controlled clinical trial. Gerodontology 2012; 29:e96-106.
9. Leroy R, Declerck D. Objective and subjective oral health care needs among adults with various disabilities. Clin Oral Invest 2013; 17:1869-1878; doi 10.1007/s00784-012-0879-x.
10. Gizani S, Declerck D, Vinckier F, Martens L, Marks L and Goffin G. Oral health condition of 12-year-old handicapped children in Flanders (Belgium). Community Dentistry and Oral Epidemiology 1997; 25: 352-357. doi: 10.1111/j.1600-0528.1997.tb00954.x
11. ICE (2004). De opzet van een dataregistratie systeem voor mondgezondheid in België - Eindrapport; available (in Dutch and French) on request at www.ice.ugent.be
12. ICE (2007). Final report on the pilot study "Oral Health Data registration System"; available (in Dutch and French) on request at www.ice.ugent.be
13. Van Oyen H, Tafforeau J, Hermans H, Quataert P, Schiettecatte E, Lebrun L, et al. The Belgian Health Interview Survey. Arch Public Health 1997;55:1-13.
14. Carvalho JC. Case Report Form for Oral Health assessments - Methodological Considerations. Brazilian Oral Res 2012; 26:10-16.
15. Slade GD, Spencer AJ. Development and evaluation of

the Oral Health Impact Profile. Community Dent Health 1994;11:3-11.

16. Löe H. The Gingival Index, the Plaque Index, and the Retention Index Systems. J Periodontol 1967;38:610-616.
17. Thylstrup A, Fejerskov O. Clinical appearance and surface distribution of dental fluorosis in permanent teeth in relation to histological changes. Community Dent Oral Epidemiol 1978;6:315-328.
18. Bartlett DW, Smith BGN. Definition, classification and clinical assessment of attrition, erosion and abrasion of enamel and dentine. In: Addy M, Embery G, Edgar WM, editors. Tooth Wear and Sensitivity-Clinical Advances in Restorative Dentistry. 1st ed. London: Martin Dunitz 2000, p87-103.
19. Kurol J, Rasmussen P. Occlusal development, preventive and interceptive orthodontics. In: Koch G, Poulsen S, editors. Pediatric Dentistry - a clinical approach. 2nd ed. Oxford: Blackwell Munksgaard 2001, p321-349.
20. van der Velden U. The Dutch periodontal screening index: validation and its application in The Netherlands. J Clin Periodontol 2009;36:1018-1024.
21. Kanno T, Carlsson GE. A review of the shortened dental arch concept focusing on the work by the Käyser/ Nijmegen group. J Oral Rehabil 2006; 33:850-862.
22. Health Surveillance in Europe - A selection of Essential Oral Health Indicators Recommended by European Global Oral Health Indicators Development Project - Bourgeois D, Llordra J, Norblad A and Pitts N eds. Catalogue, 2005.
23. Carvalho JC, Bottenberg P, Declerck D, Van Nieuwenhuysen JP, Vanobbergen J, Nyssen M. Validity of an Information and Communication Technology System for Data Capture in Epidemiological Studies. Caries Res 2011;45:287-293.

APPENDIX

Statistical analysis details

In order to provide estimates representative for the Belgian population, a weighted analysis should be performed. Given the fact that the sample was drawn by an independent organization, no selection probabilities at each stage nor jointly were available. Therefore approximate sampling weights were calculated. Based on 5-year age categories stratified by province, the weights were calculated as follows:

1.$P_{pop}=N_{sample} / N_{pop}$ for each province where N_{sample} and N_{pop} represent the number of patients in the sample and population in each province, respectively.

2.$P_{age}= N_{age\_sample} / N_{age\_pop}$ for each 5-year age category per province where N_{age_sample} and N_{age_pop} represent the number of patients in the sample and population in each age category per province, respectively.

3.$P_{final} = P_{pop}*P_{age}$

4.$W_1 =1/P_{final}$

5.$W_{final} = W_1 / \Sigma w1 * 1{,}0511{,}382$

No correction for non-participation nor non-response was made. In addition to the weights, clustering within PSUs will be taken into account in variance estimation in statistical analyses.

List of acronyms

- ***DPSI:*** Dutch Periodontal Screening Index
- ***EGOHID:*** European Global Oral Health Indicators Development project
- ***HES:*** Health Examination Survey
- ***HIS:*** Health Interview Survey
- ***ICE:*** Interuniversity Consortium of Epidemiology
- ***IMA:*** Inter-Mutualistic Agency
- ***IPH:*** Scientific Institute of Public Health
- ***NIHDI:*** Belgian National Institute for Health and Disability Insurance
- ***NRN:*** National Register Number
- ***OHDRES:*** Oral Health Data Registration and Evaluation System
- ***OHIP-14:*** Oral Health related quality of life questionnaire (Oral Heath Impact Profile-14)
- ***PSU:*** Primary Sampling Units
- ***SSU:*** Secondary Sampling Units